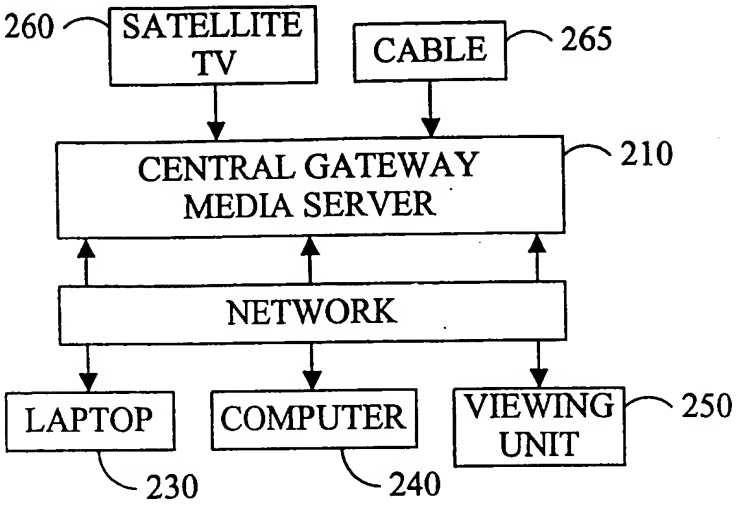


FIG. 1

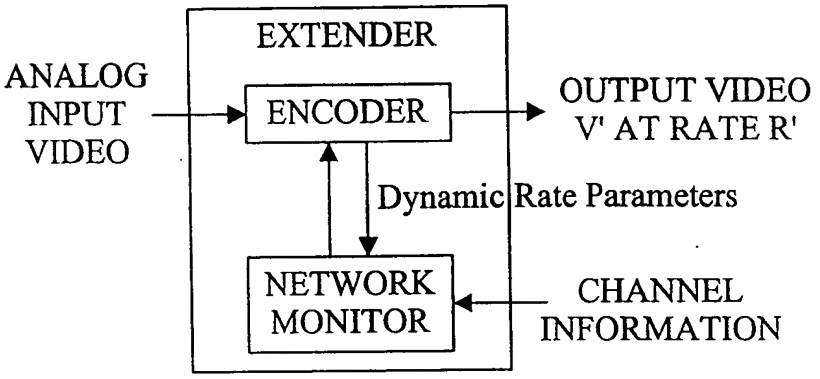


FIG. 2

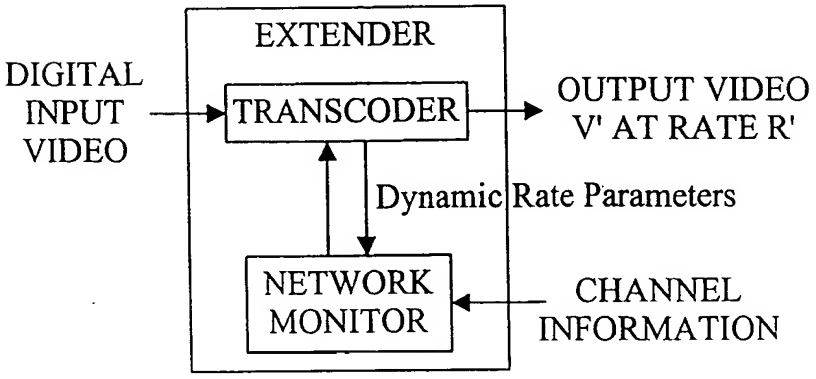


FIG. 3

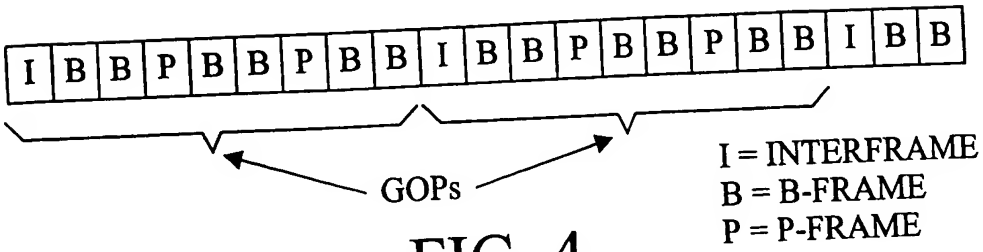


FIG. 4

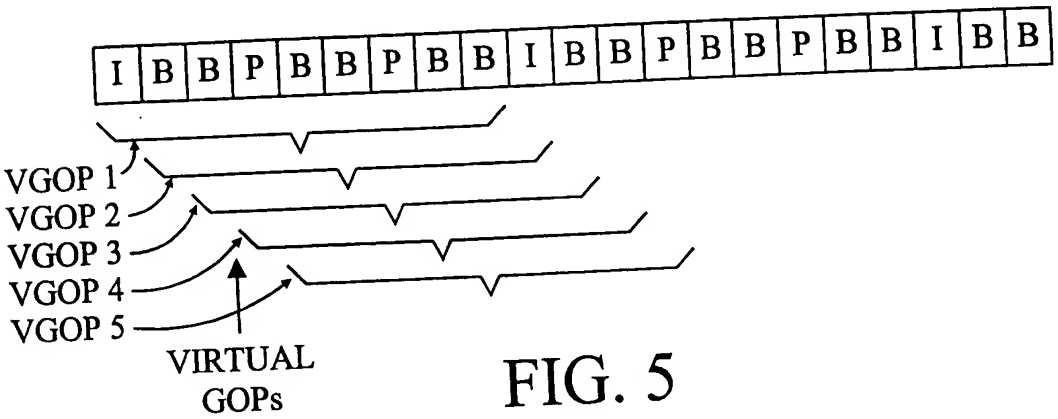


FIG. 5

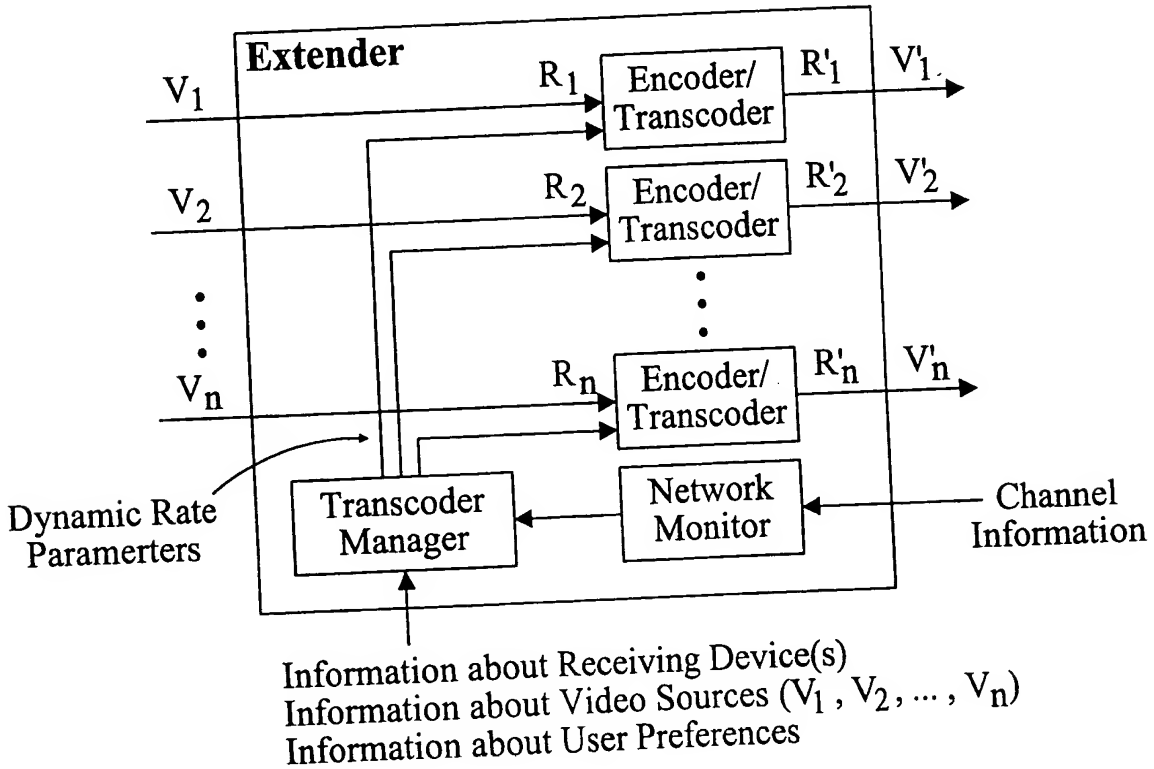


FIG. 6

FIG. 7

FIG. 8

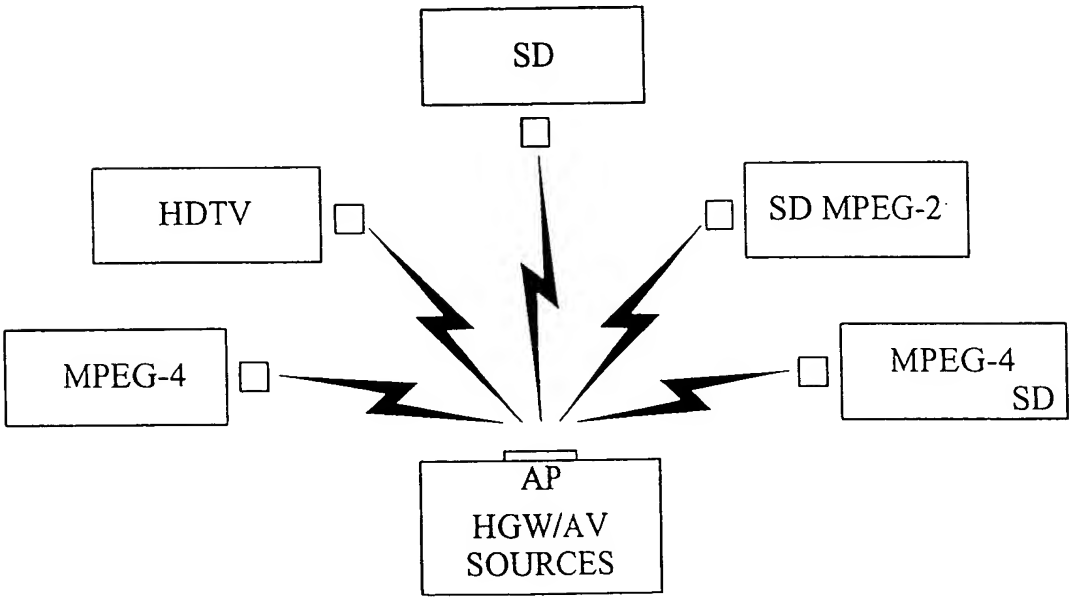


FIG. 9

(MPEG-2 TM5):

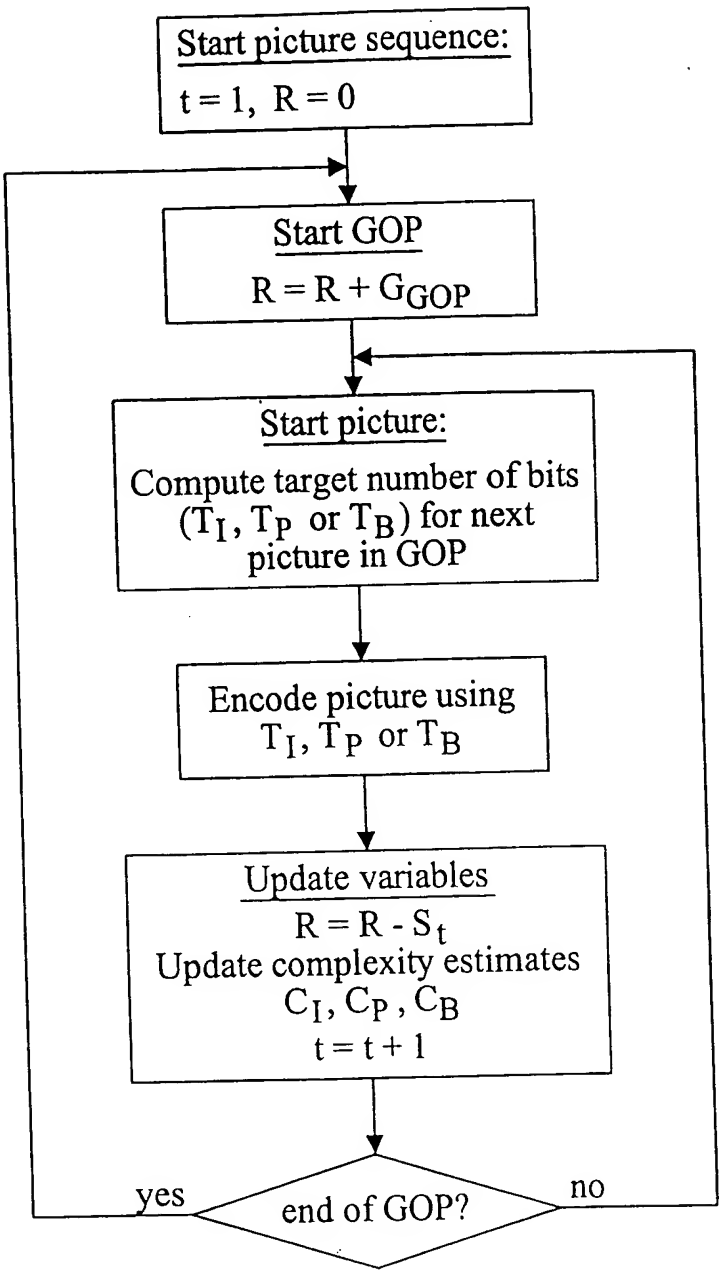


FIG. 10

Dynamic rate adaptation with Virtual GOPs (VGOPs)

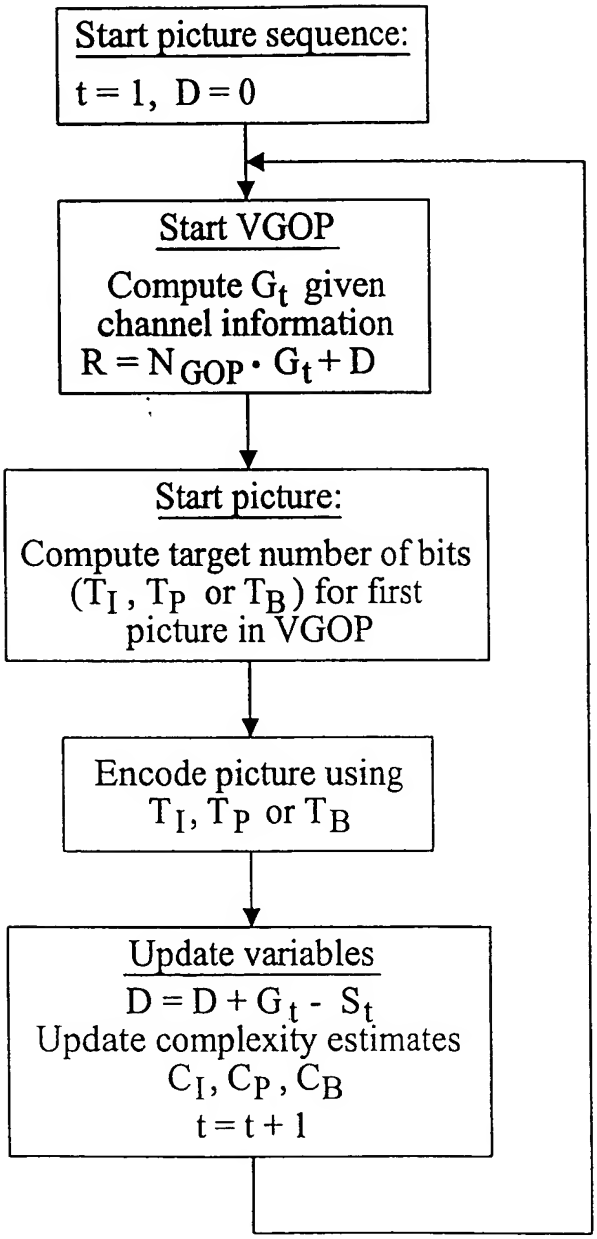


FIG. 11

No or slowly varying channel conditions - super-GOP-by-GOP bit allocation (MPEG-2)

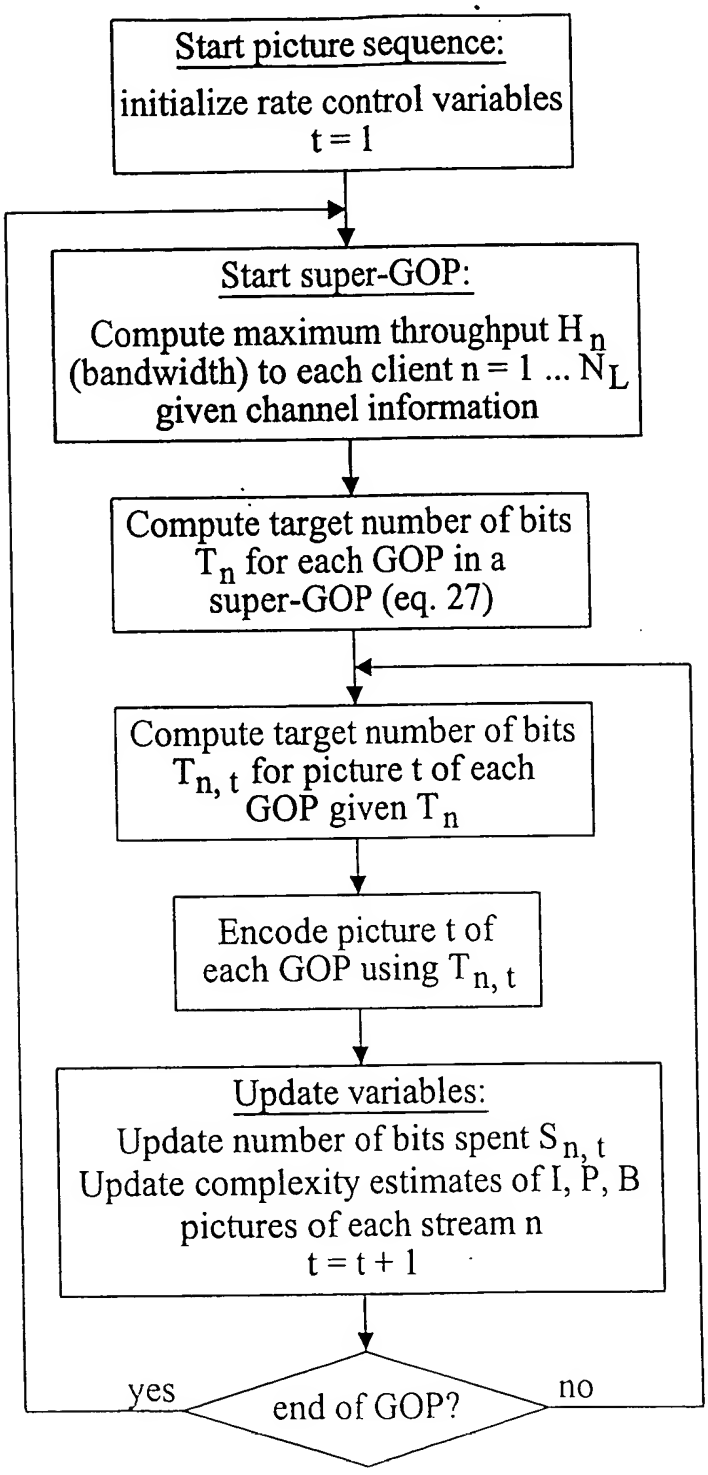


FIG. 12

Dynamic channel conditions -
virtual-super-GOP-by-virtual-super-GOP bit allocation

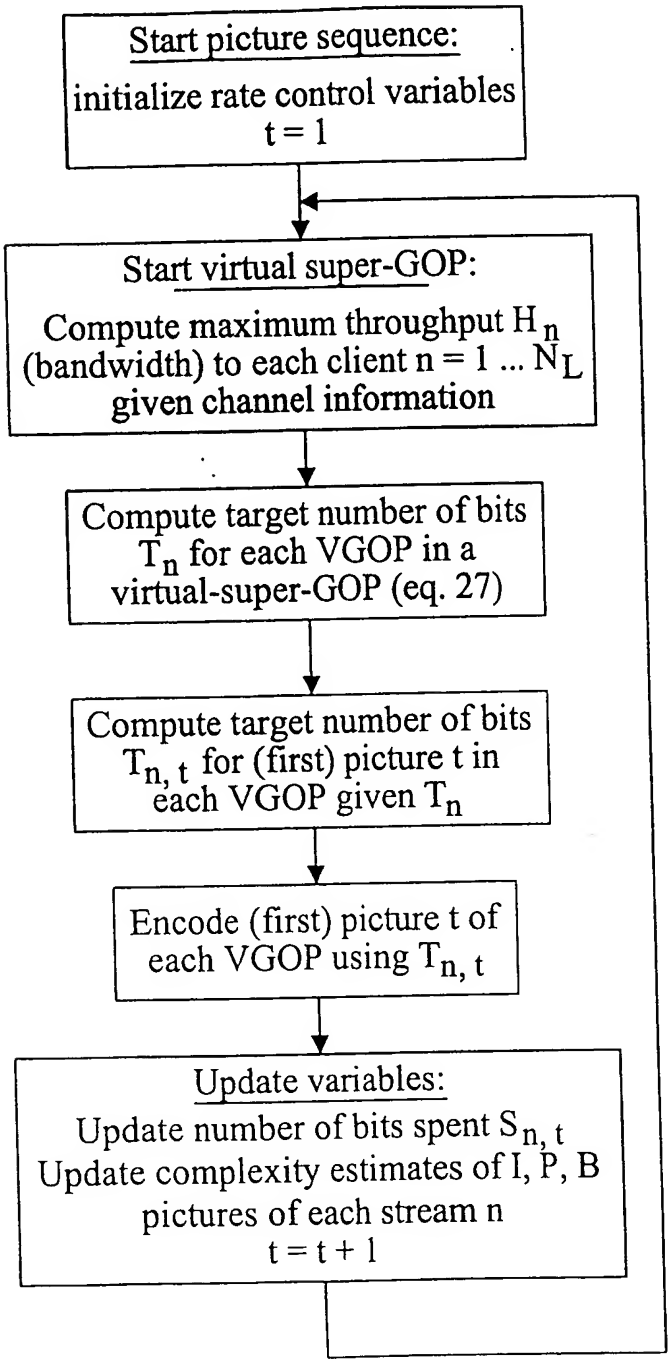


FIG. 13

Dynamic channel conditions -
super-frame-by-super-frame bit allocation (no GOPs)

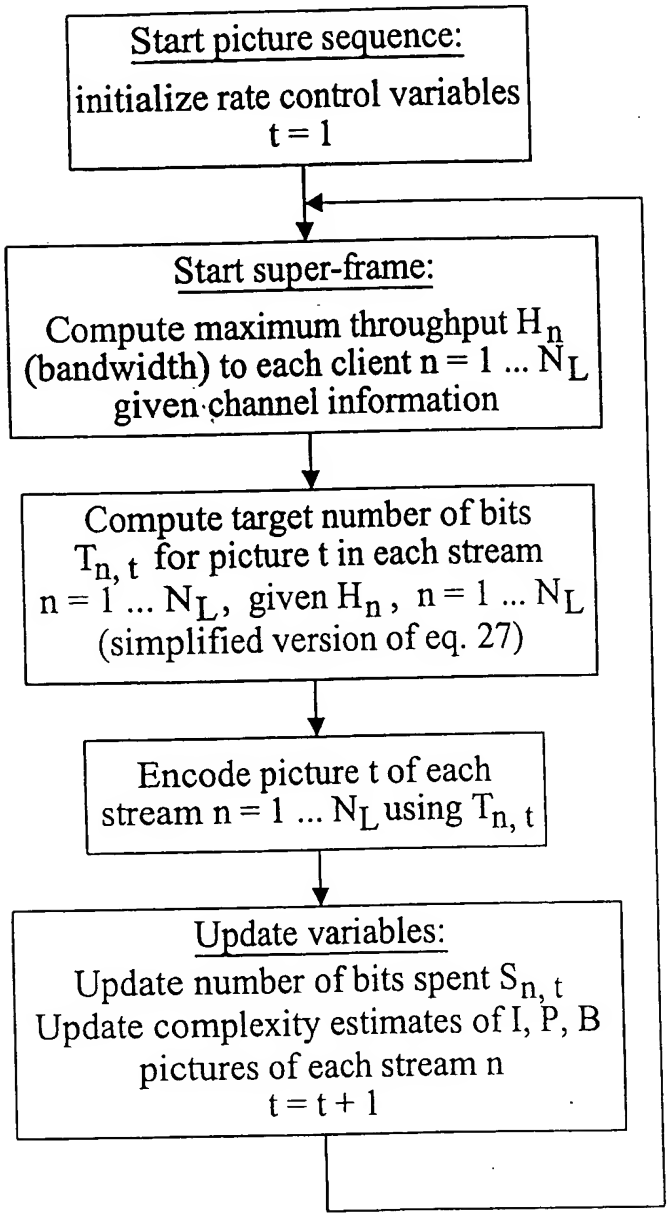


FIG. 14

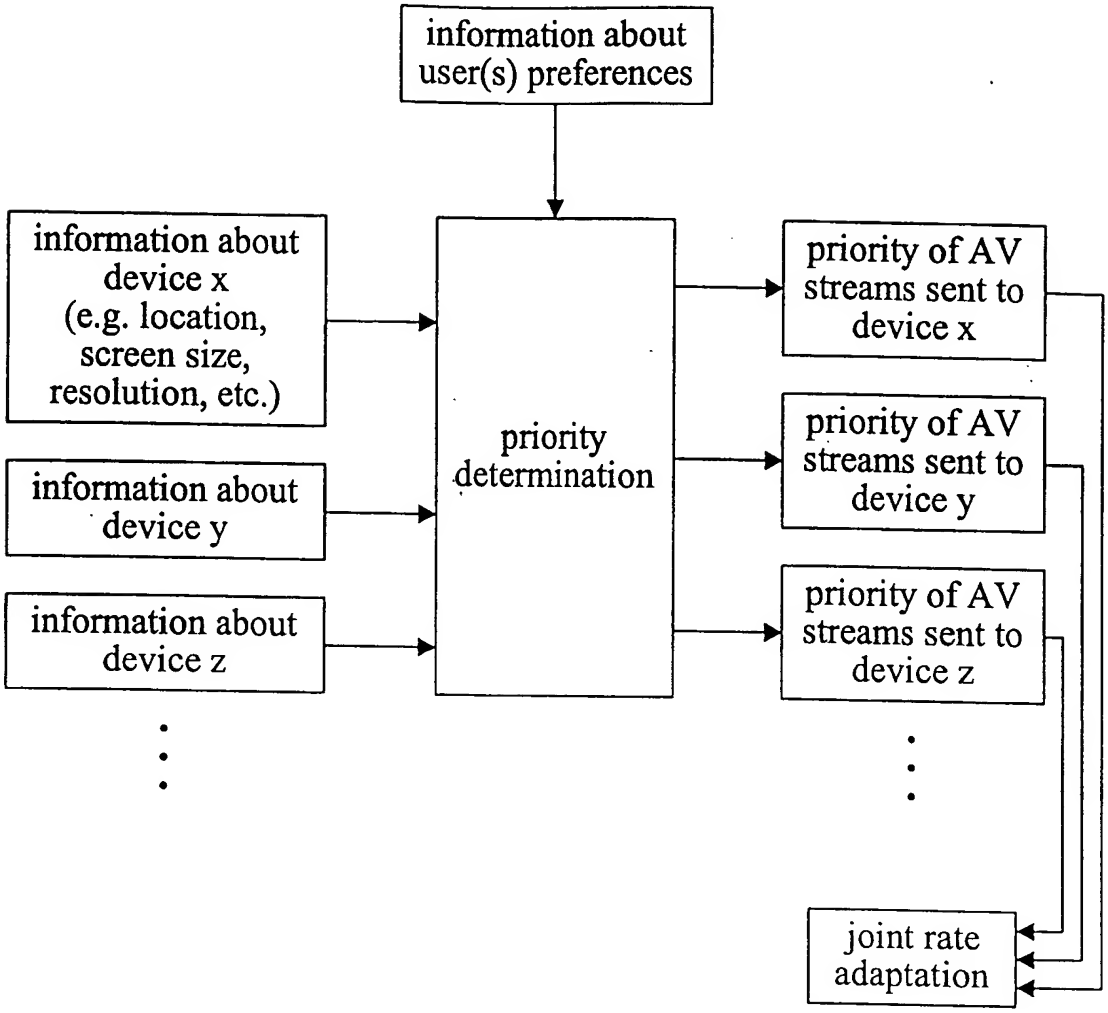

information about user(s) preferences
information about device x (e.g. location, screen size, resolution, etc.)
information about device y
information about device z
priority determination
priority of AV streams sent to device x
priority of AV streams sent to device y
priority of AV streams sent to device z
joint rate adaptation

FIG. 15

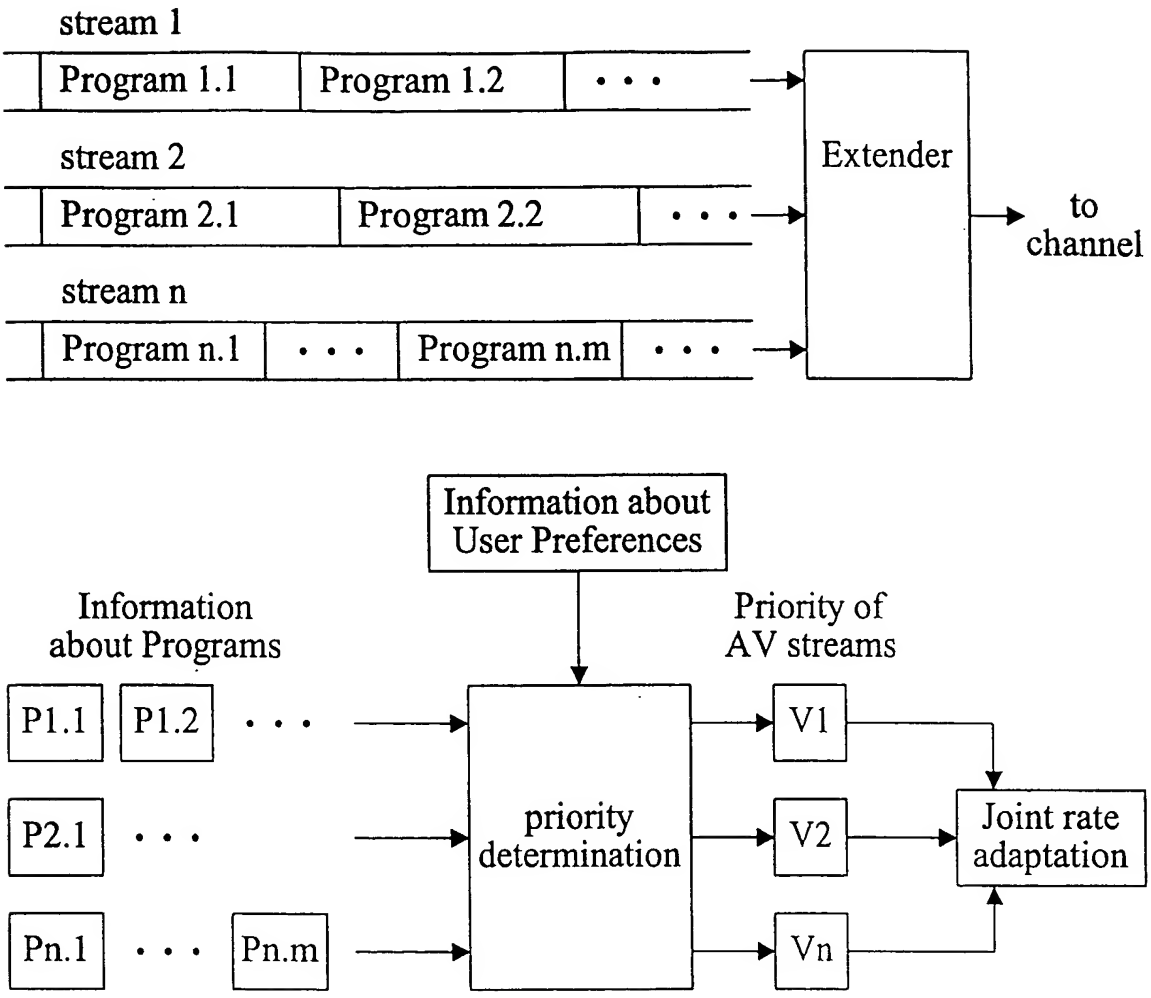

stream 1
Program 1.1
Program 1.2
stream 2
Program 2.1
Program 2.2
stream n
Program n.1
Program n.m
Extender
to channel
Information about User Preferences
Information about Programs
Priority of AV streams
P1.1
P1.2
P2.1
Pn.1
Pn.m
priority determination
V1
V2
Vn
Joint rate adaptation

FIG. 16

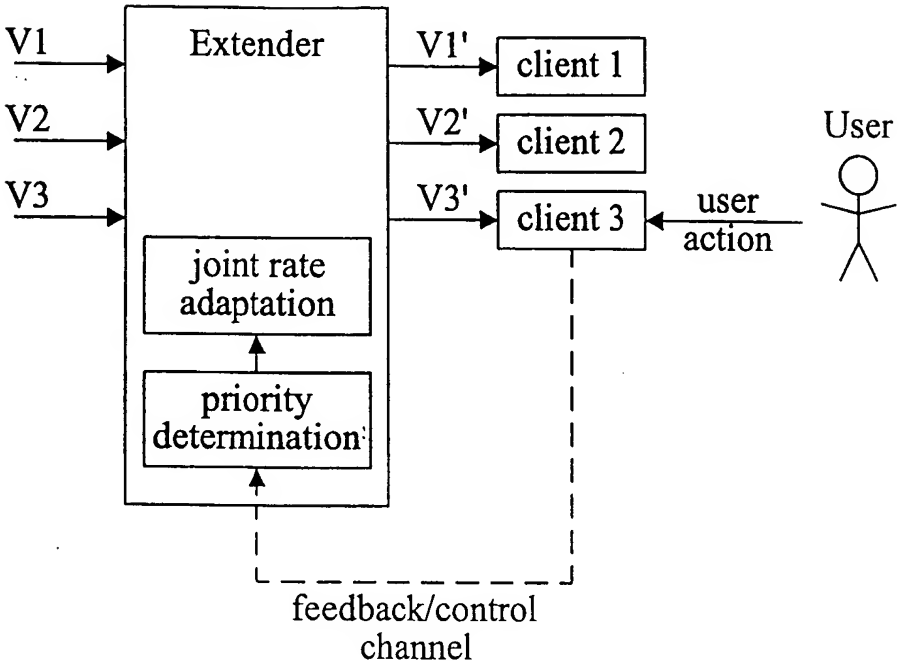

V1
V2
V3
Extender
joint rate adaptation
priority determination
V1'
V2'
V3'
client 1
client 2
client 3
user action
User
feedback/control channel

FIG. 17

Invention: WIRELESS VIDEO TRANSMISSION SYSTEM
Applicant: Petrus J.L. van Beek
Filed: Concurrently herewith Attorney: Kevin L. Russell, Reg. No. 38,292
Docket No. 7146.0168 Telephone: (503) 227-5631

Idealized model of MAC (using 802.11 DCF)

- Channel condition deterioration will cause:
  - Re-transmissions of lost packets
  - Fallback to lower data link rates

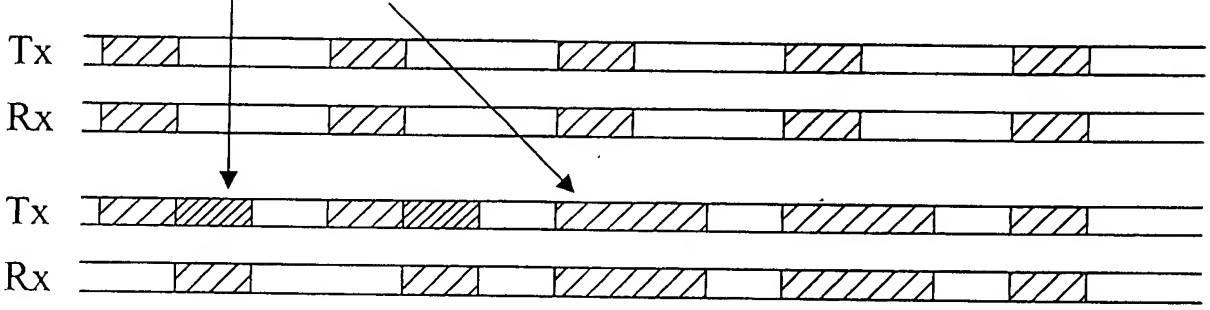


FIG. 18

A model-based approach at the video layer (1 stream case)

- Measure packet transmission and arrival times:
  - Measurements by application/video layer (outside MAC)
  - Variation in packet arrival times indicate changes of data link rate and retransmissions

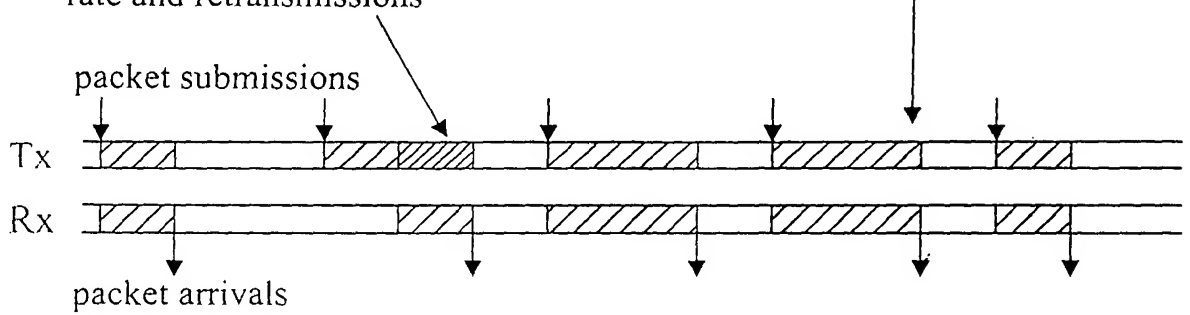


FIG. 19

- Packet burst approach

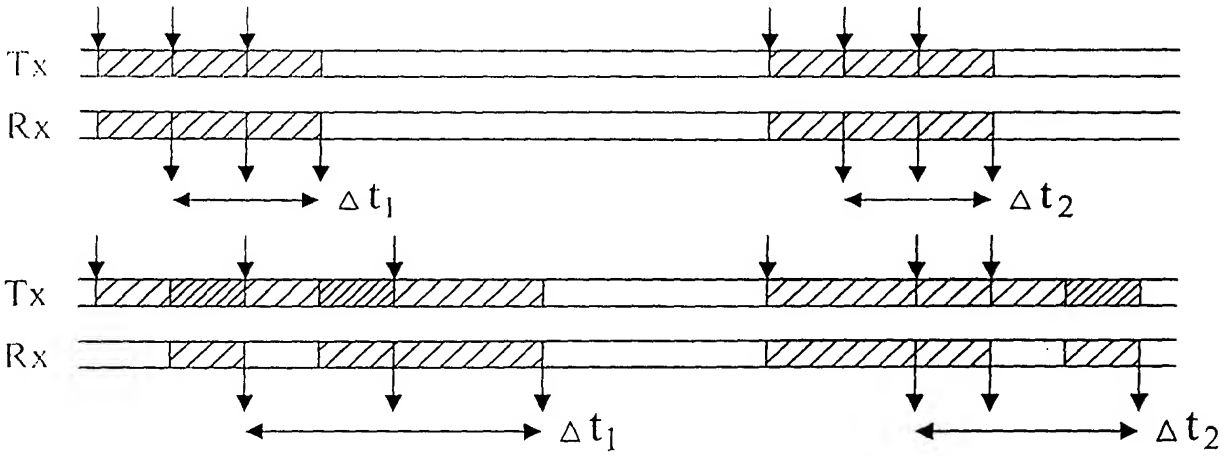


FIG. 20

Drawings - Sheet 13 of 19
Invention: WIRELESS VIDEO TRANSMISSION SYSTEM
Applicant: Petrus J.L. van Beek
Filed: Concurrently herewith
Attorney: Kevin L. Russell, Reg. No. 38,292
Docket No. 7146.0168
Telephone: (503) 227-5631

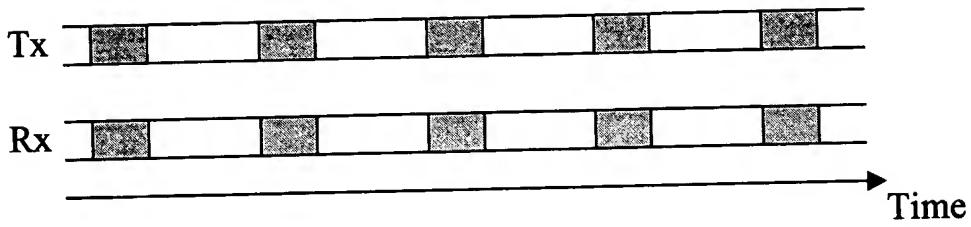


FIG. 21

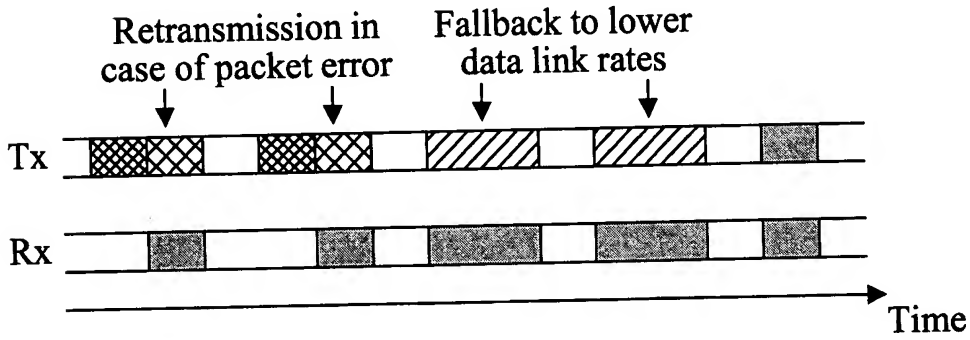


FIG. 22

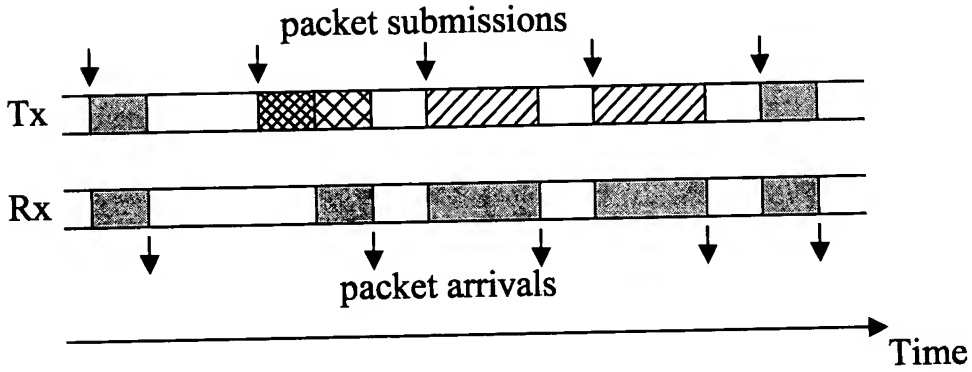


FIG. 23

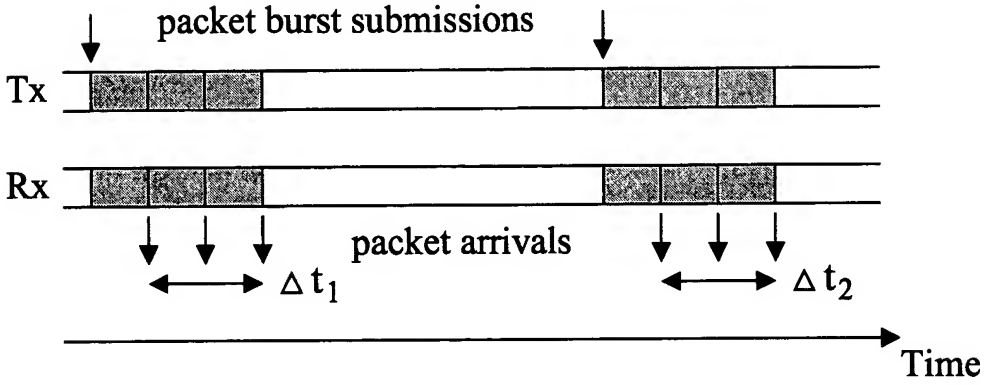

packet burst submissions
Tx
Rx
packet arrivals
Δt1
Δt2
Time

FIG. 24

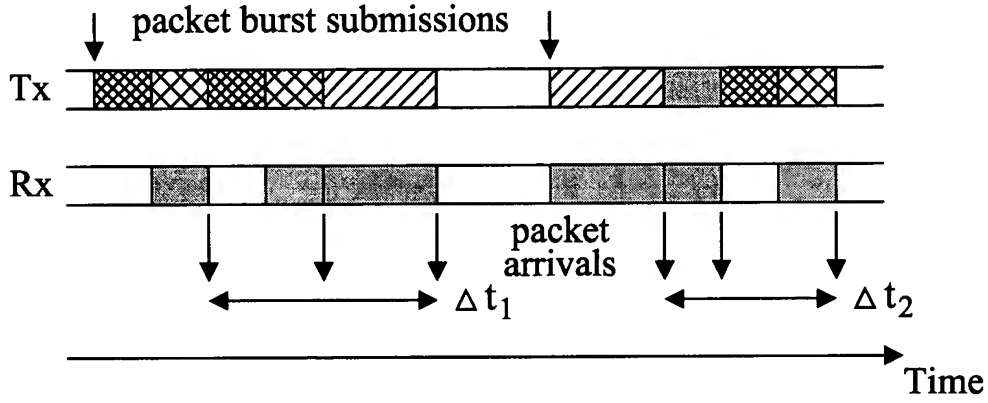
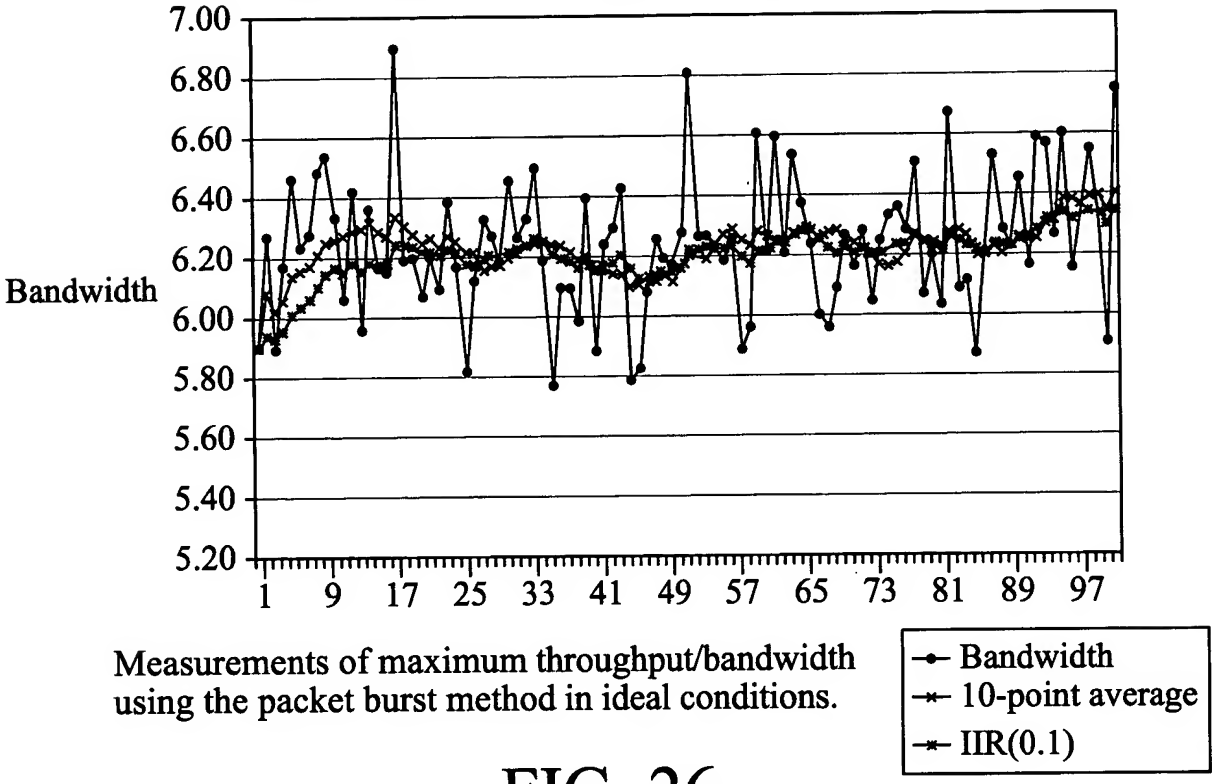
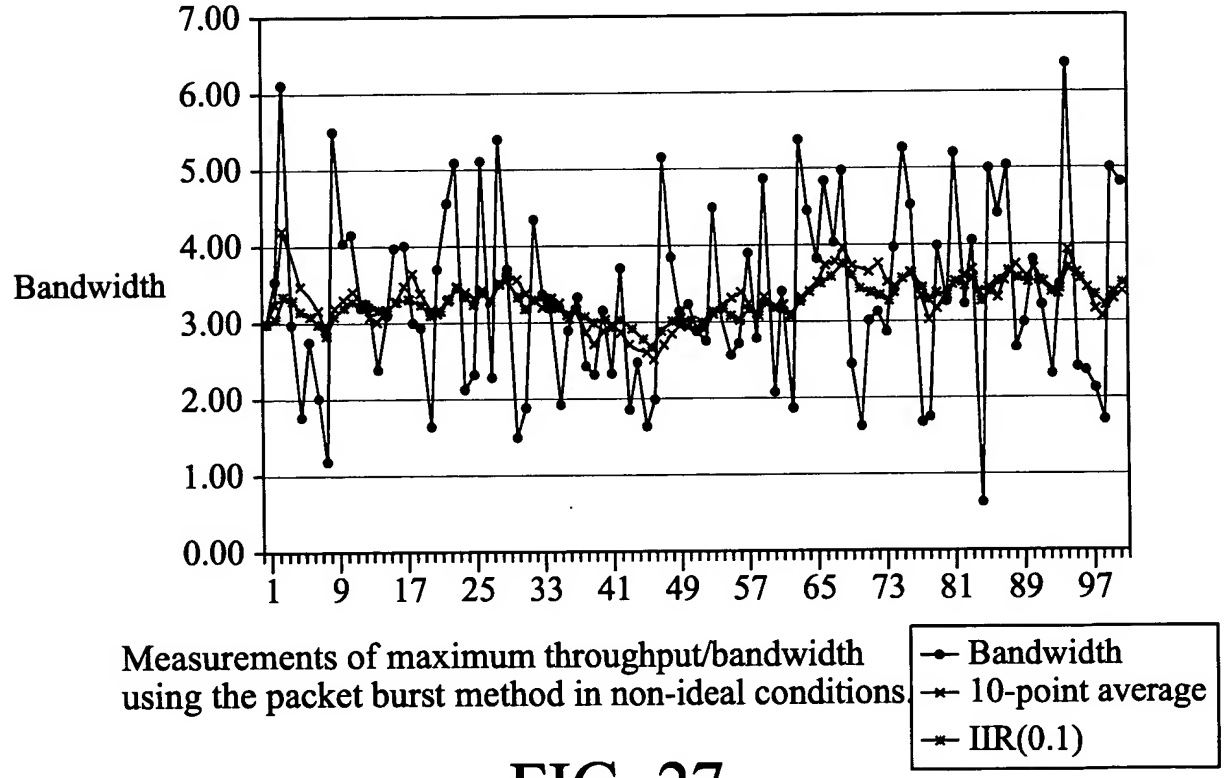

packet burst submissions
Tx
Rx
packet
arrivals
Δt1
Δt2
Time

FIG. 25



Measurements of maximum throughput/bandwidth using the packet burst method in ideal conditions.

FIG. 26



Measurements of maximum throughput/bandwidth using the packet burst method in non-ideal conditions.

FIG. 27

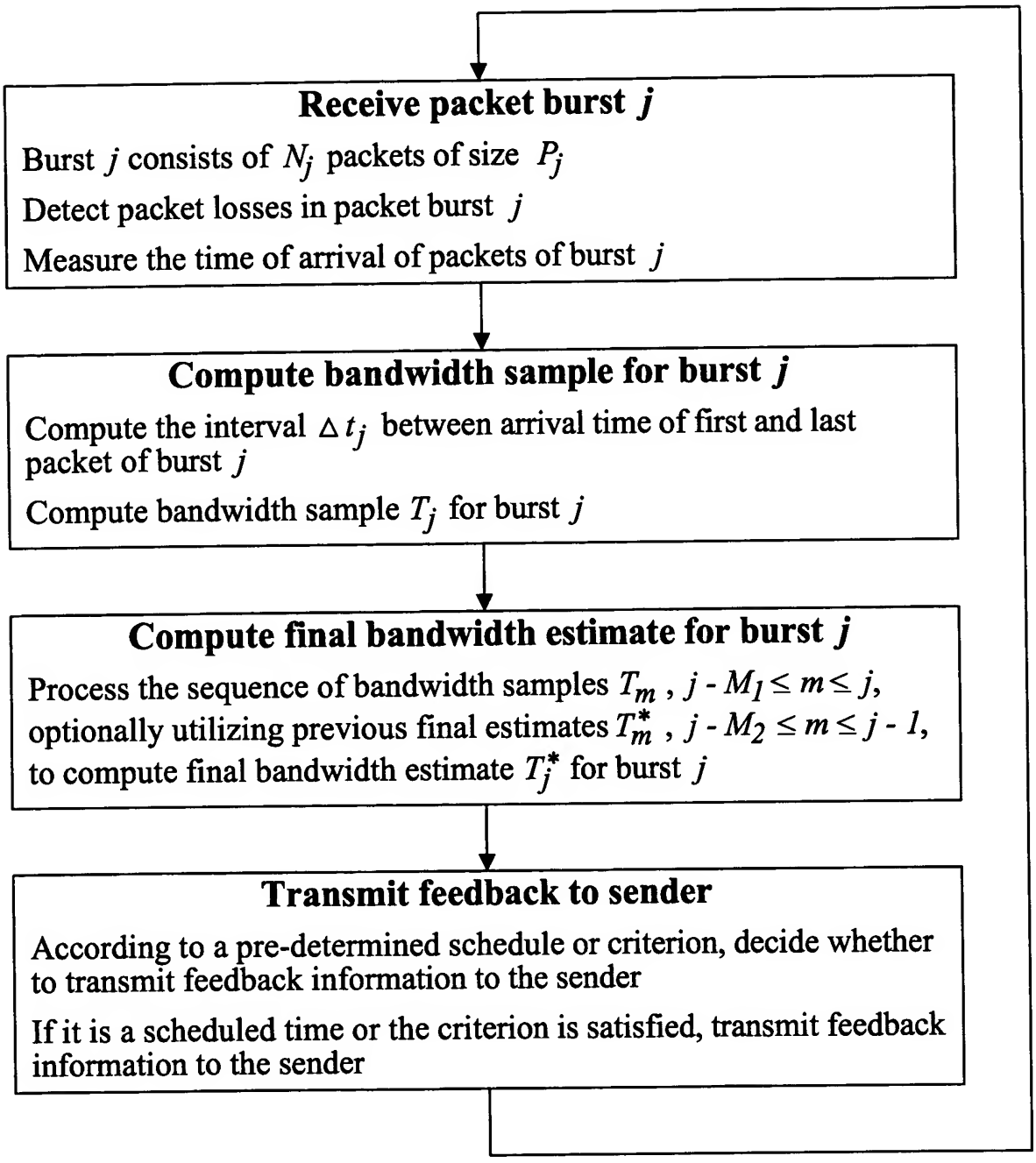

Receive packet burst j
Burst j consists of N_j packets of size P_j
Detect packet losses in packet burst j
Measure the time of arrival of packets of burst j
Compute bandwidth sample for burst j
Compute the interval Δt_j between arrival time of first and last packet of burst j
Compute bandwidth sample T_j for burst j
Compute final bandwidth estimate for burst j
Process the sequence of bandwidth samples T_m , $j - M_1 \leq m \leq j$, optionally utilizing previous final estimates T_m^* , $j - M_2 \leq m \leq j - 1$, to compute final bandwidth estimate T_j^* for burst j
Transmit feedback to sender
According to a pre-determined schedule or criterion, decide whether to transmit feedback information to the sender
If it is a scheduled time or the criterion is satisfied, transmit feedback information to the sender

FIG. 28A

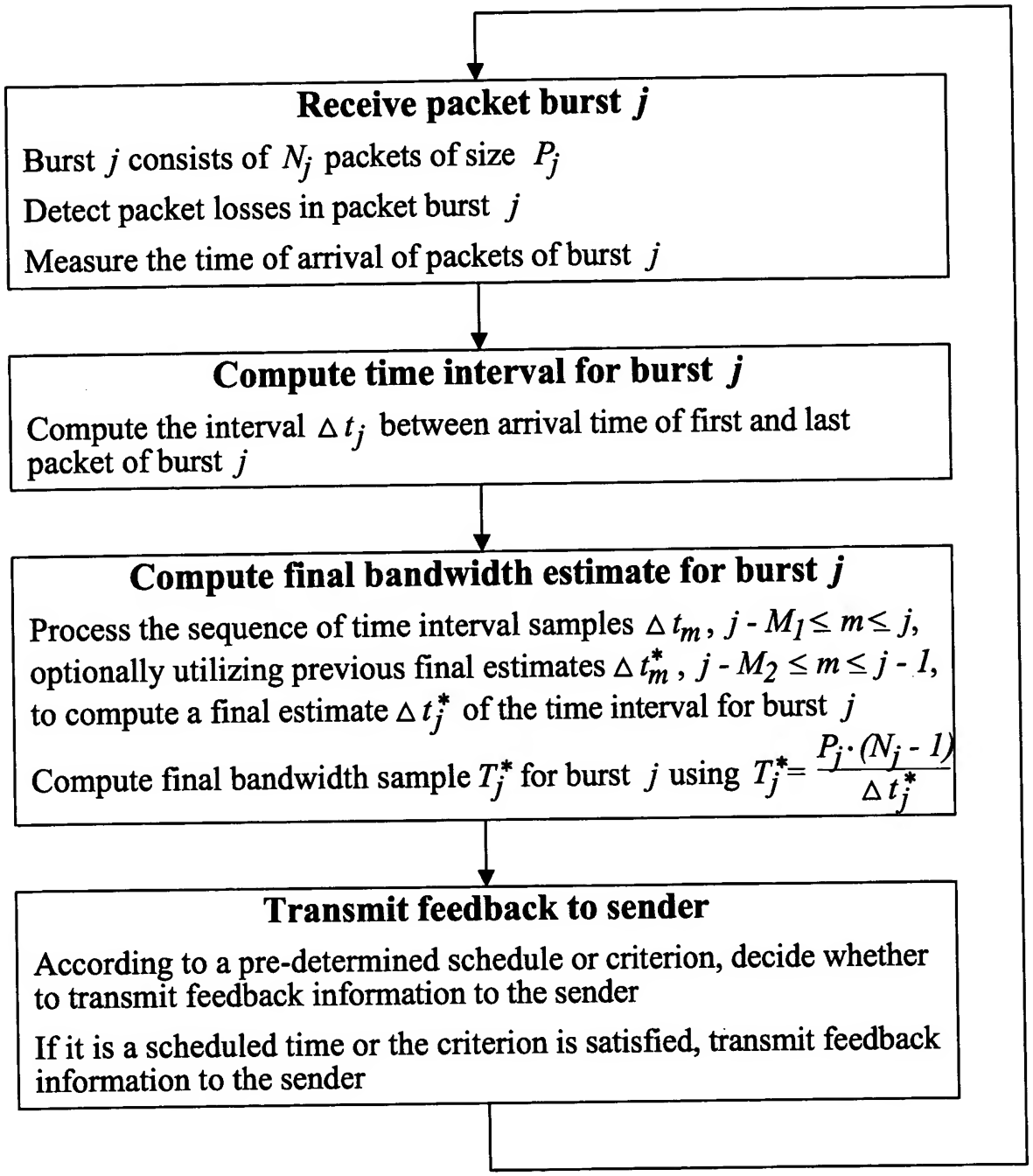

Receive packet burst j
Burst j consists of N_j packets of size P_j
Detect packet losses in packet burst j
Measure the time of arrival of packets of burst j
Compute time interval for burst j
Compute the interval Δt_j between arrival time of first and last packet of burst j
Compute final bandwidth estimate for burst j
Process the sequence of time interval samples Δt_m, $j - M_1 \le m \le j$, optionally utilizing previous final estimates Δt_m^*, $j - M_2 \le m \le j - 1$, to compute a final estimate Δt_j^* of the time interval for burst j
Compute final bandwidth sample T_j^* for burst j using $T_j^* = \frac{P_j \cdot (N_j - 1)}{\Delta t_j^*}$
Transmit feedback to sender
According to a pre-determined schedule or criterion, decide whether to transmit feedback information to the sender
If it is a scheduled time or the criterion is satisfied, transmit feedback information to the sender

FIG. 28B

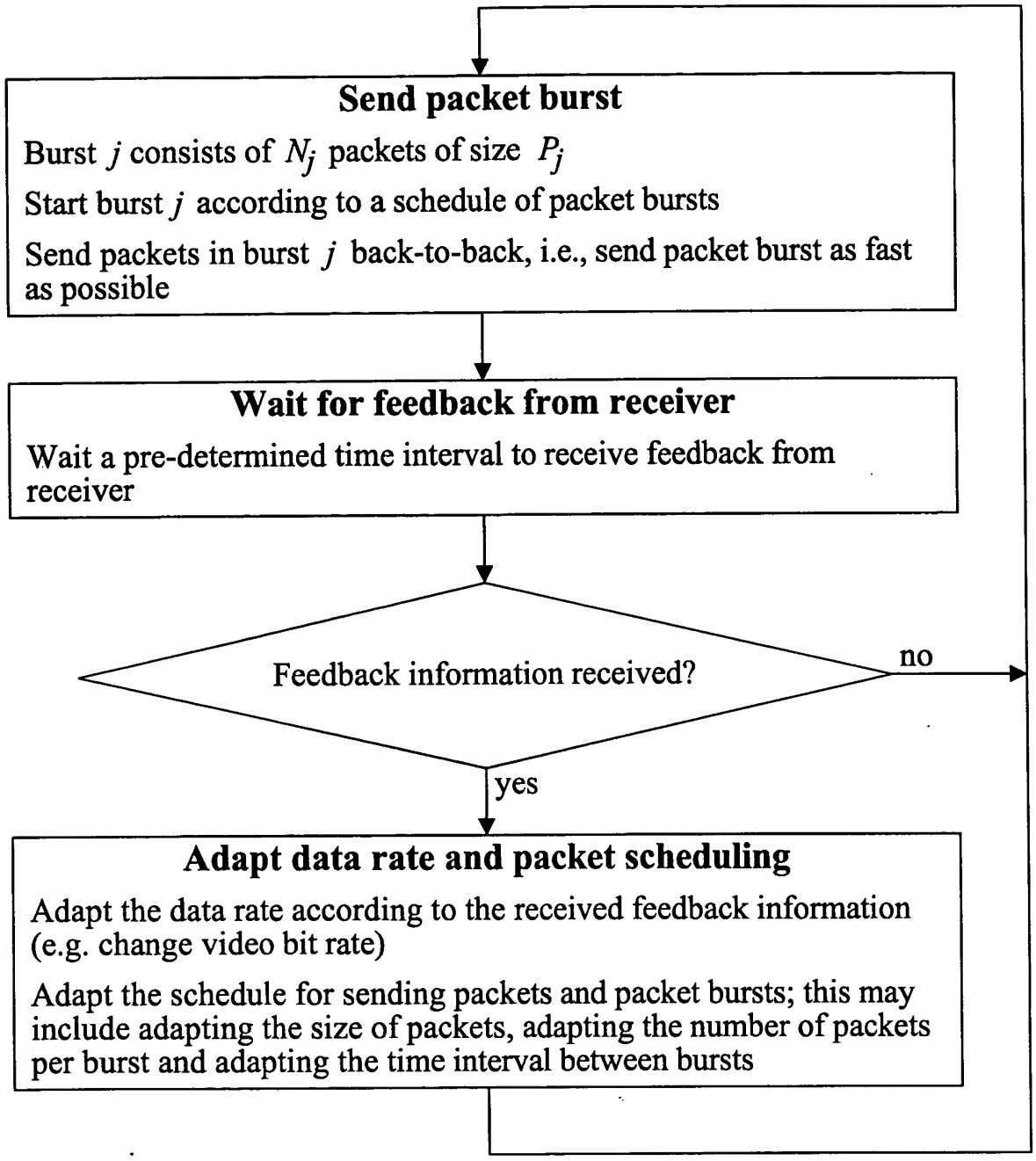

Send packet burst
Burst j consists of N_j packets of size P_j
Start burst j according to a schedule of packet bursts
Send packets in burst j back-to-back, i.e., send packet burst as fast as possible
Wait for feedback from receiver
Wait a pre-determined time interval to receive feedback from receiver
Feedback information received?
no
yes
Adapt data rate and packet scheduling
Adapt the data rate according to the received feedback information (e.g. change video bit rate)
Adapt the schedule for sending packets and packet bursts; this may include adapting the size of packets, adapting the number of packets per burst and adapting the time interval between bursts

FIG. 29